

MAR 30 1990

FEM 1.209: 125099/990

FLOOD INSURANCE STUDY



CITY OF DAYTONA BEACH,
FLORIDA
VOLUSIA COUNTY

JUNE 4 1990



Federal Emergency Management Agency

COMMUNITY NUMBER - 125099

NOTICE TO
FLOOD INSURANCE STUDY USERS

Communities participating in the National Flood Insurance Program have established repositories of flood hazard data for floodplain management and flood insurance purposes. This Flood Insurance Study may not contain all data available within the repository. It is advisable to contact the community repository for any additional data.

TABLE OF CONTENTS

	<u>Page</u>
1.0 <u>INTRODUCTION</u>	1
1.1 Purpose of Study	1
1.2 Authority and Acknowledgments	1
1.3 Coordination	2
2.0 <u>AREA STUDIED</u>	2
2.1 Scope of Study	2
2.2 Community Description	2
2.3 Principal Flood Problems	4
2.4 Flood Protection Measures	4
3.0 <u>ENGINEERING METHODS</u>	4
3.1 Hydrologic Analyses	4
3.2 Hydraulic Analyses	6
4.0 <u>FLOODPLAIN MANAGEMENT APPLICATIONS</u>	11
4.1 Floodplain Boundaries	12
4.2 Floodways	12
5.0 <u>INSURANCE APPLICATION</u>	13
6.0 <u>FLOOD INSURANCE RATE MAP</u>	15
7.0 <u>OTHER STUDIES</u>	15
8.0 <u>LOCATION OF DATA</u>	16
9.0 <u>REFERENCES AND BIBLIOGRAPHY</u>	16

TABLE OF CONTENTS (continued)

Page

FIGURES

Figure	1	-	Vicinity Map	3
Figure	2	-	Transect Location Map	9
Figure	3	-	Transect Schematic	10
Figure	4	-	Floodway Schematic	13

TABLES

Table	1	-	Summary of Discharges	5
Table	2	-	Summary of Stillwater Elevations	7
Table	3	-	Transect Locations, Stillwater Starting Elevations, and Initial Wave Crest Elevations	10
Table	4	-	Floodway Data	14

EXHIBITS

Flood Profiles

Tomoka River	Panel 01P
Eleventh Street Canal	Panel 02P
Canal Between	Panel 03P
Wally Hoffmeyer Canal	Panel 04P

Flood Insurance Rate Map Index
Flood Insurance Rate Map

FLOOD INSURANCE STUDY
CITY OF DAYTONA BEACH,
VOLUSIA COUNTY,
FLORIDA

1.0 INTRODUCTION

1.1 Purpose of Study

This Flood Insurance Study revises and supersedes a previous Flood Insurance Study for the City of Daytona Beach, Florida (Reference 1). This information will be used by the community to update existing floodplain regulations as part of the regular phase of the National Flood Insurance Program. The information will also be used by local and regional planners to further promote sound land use and floodplain development.

In some states or communities, floodplain management criteria or regulations may exist that are more restrictive or comprehensive than the minimum Federal requirements. In such cases, the more restrictive criteria take precedence and the State (or other jurisdictional agency) will be able to explain them.

This Flood Insurance Study was prepared by compiling existing hydrologic and hydraulic technical and scientific data for the coastal flooding sources within the community prepared by the Federal Emergency Management Agency (FEMA) for purposes of the National Flood Insurance Program. A study titled "Tomoka River and B-19 Canal 100-year Flood Results for the City of Daytona Beach" (Reference 2) contains hydrologic and hydraulic information for the Tomoka River and its tributaries and for the B-19 Canal within the City of Daytona Beach. The data were identified as the best available at the time of compilation of this Flood Insurance Study and should depict the general conditions of the flooding sources with relative accuracy. FEMA performed a cursory review and accepted the data as valid for purposes of this Flood Insurance Study and the National Flood Insurance Program. However, if better information is known to exist or has been developed since the date of this report, the information should be immediately forwarded to the Natural and Technological Hazards Division, FEMA, Atlanta, Georgia, for consideration for revision of this study.

1.2 Authority and Acknowledgments

The sources of authority for this Flood Insurance Study are the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

The hydrologic and hydraulic analyses for this study were obtained from the Flood Insurance Study for Volusia County, Florida (Reference 3) and the study titled "Tomoka River and B-19 Canal 100-year Flood Results" (Reference 2).

1.3 Coordination

On August 12, 1987, the results of this Flood Insurance Study were reviewed and accepted at a final coordination meeting attended by representatives of the community and FEMA.

2.0 AREA STUDIED

2.1 Scope of Study

This Flood Insurance Study covers the unincorporated area of the City of Daytona Beach, Volusia County, Florida. The area of study is shown on the Vicinity Map (Figure 1).

The areas studied by detailed methods were selected based on the extent and validity of available existing hydrologic and hydraulic data.

Flooding caused by overflow of the Tomoka River, the Tomoka River tributaries, Wally Hoffmeyer Canal, Eleventh Street Canal, and Canal Between affects the community and was studied in detail.

Shallow flooding from other tributaries in the Tomoka River basin and in the B-19 Canal basin also affects the community.

A detailed coastal flooding analysis was performed on the complete coastline of the City of Daytona Beach, where the flooding source is the Atlantic Ocean.

Approximate methods of analysis were used to study all remaining areas having a potential flood hazard that did not have detailed scientific or technical data available.

2.2 Community Description

The City of Daytona Beach is in northeastern Volusia County. The city is bordered on the east by the Atlantic Ocean, on the south by the City of South Daytona, on the west by the City of Holly Hill and the City of Port Orange, and on the north by the Cities of Ormond Beach and Holly Hill, and by the unincorporated areas of Volusia County on the north, south, and west. The City of Daytona Beach is served by Interstate 95, U.S. Routes 92 and 1, and the Florida East Coast Railway. The 1980 population of the city was reported to be 54,176 (Reference 4).

Precipitation within the study area ranges between 48 inches and 64 inches per year. Due to hurricane activity, the precipitation range varies. The annual mean temperature for the City of Daytona Beach is approximately 70 degrees Fahrenheit.

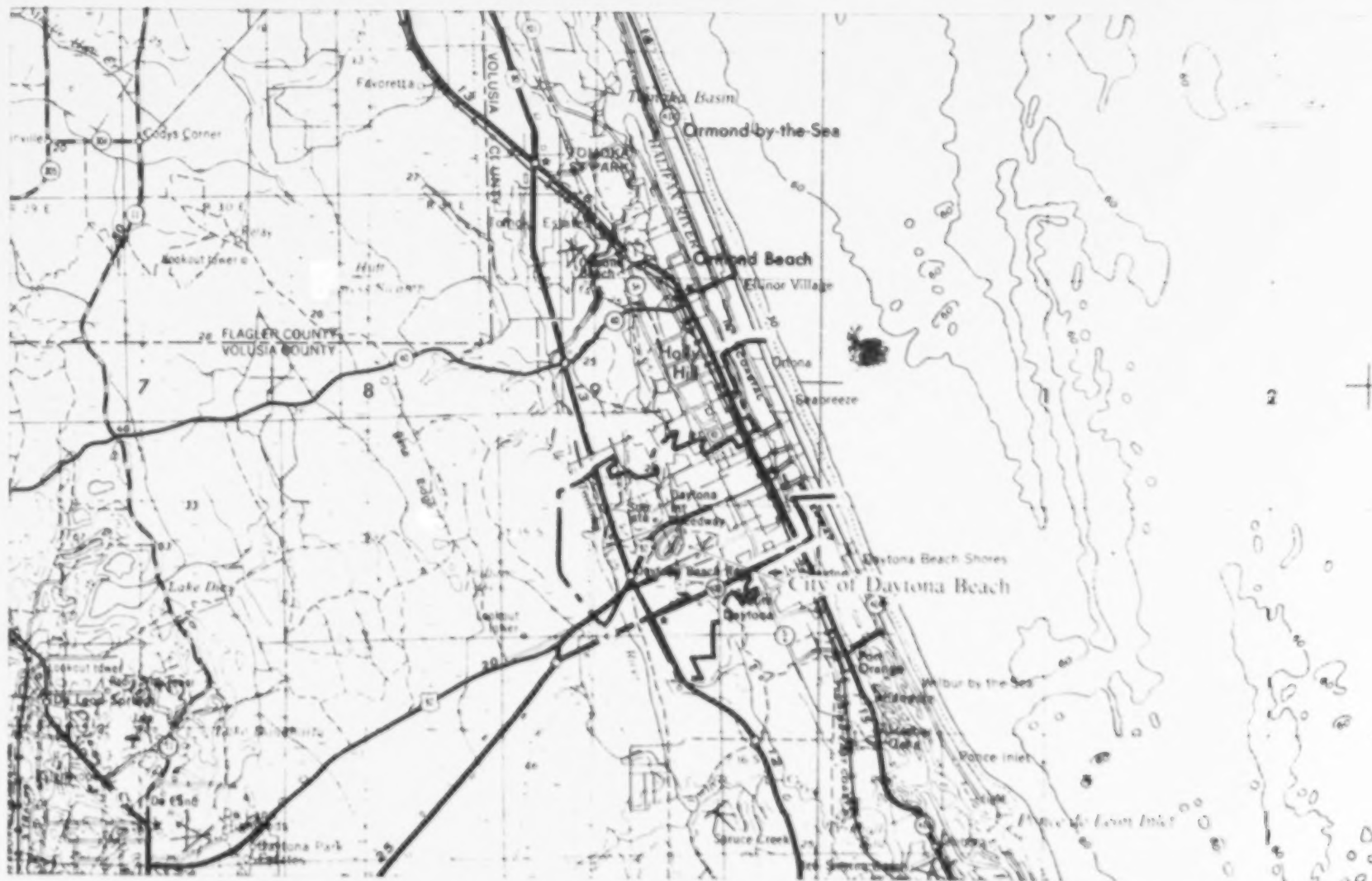


FIGURE 1

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF DAYTONA BEACH, FL
(VOLUSIA CO.)

APPROXIMATE SCALE

0 1 2 3 4 5 6 7 8 9 10 MILES

VICINITY MAP

3

2.3 Principal Flood Problems

The City of Daytona Beach is subject to flooding from tidal surges that accompany hurricanes and other severe storms. Tidal flooding occurs along the open coast and along the mainland areas adjacent to the Halifax River.

The Tomoka River, B-19 Canal, and their tributaries are also subject to flooding during periods of heavy rainfall.

2.4 Flood Protection Measures

Flood protection measures are not known to exist within the study area.

3.0 ENGINEERING METHODS

For the flooding sources studied in detail in the community, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this study. Flood events of a magnitude that are expected to be equaled or exceeded once on the average during any 10-, 50-, 100-, or 500-year period (recurrence interval) have been selected as having special significance for floodplain management and for flood insurance rates. These events, commonly termed the 10-, 50-, 100-, and 500-year floods, have a 10-, 2-, 1-, and 0.2-percent chance, respectively, of being equaled or exceeded during any year. Although the recurrence interval represents the long-term average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than 1 year are considered. For example, the risk of having a flood that equals or exceeds the 100-year flood (1-percent chance of annual exceedence) in any 50-year period is approximately 40-percent (4 in 10), and, for any 90-year period, the risk increases to approximately 60-percent (6 in 10). The analyses reported herein reflect flooding potentials based on conditions existing in the community at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish the peak discharge-frequency relationships for each riverine flooding source studied in detail affecting the community. Analyses were also carried out to establish the peak elevation-frequency relationships for each coastal flooding source studied in detail.

The runoff block of the U.S. Environmental Protection Agency Stormwater Management Model (SWMM) (References 5 and 6), as modified by Camp Dresser & McKee, was used to generate runoff hydrographs and to perform simplified lake/channel/conduit routing for the Tomoka River, the Tomoka River tributaries and the B-19 Canal. Detailed information on the hydrologic parameters is contained in the study titled "Tomoka River and B-19 Canal 100-year Flood Results for the City of Daytona Beach" (Reference 2). The drainage areas for the Tomoka River and the Tomoka River tributaries were obtained from this model. The EXTRAN model (Reference 7) performs hydraulic routing in the downstream reaches of the watershed.

The discharges for the Tomoka River and the Tomoka River tributaries were obtained from the EXTRAN model.

Peak discharge-drainage area relationships for the 100-year flood of each flooding source studied in detail in the community are shown in Table 1.

TABLE 1 - SUMMARY OF DISCHARGES

<u>FLOODING SOURCE AND LOCATION</u>	<u>DRAINAGE AREA (SQ MILES)</u>	<u>PEAK DISCHARGE (CFS) 100-YEAR</u>
TOMOKA RIVER at Eleventh Street	76.63	5,891
WALLY HOFFMEYER CANAL at mouth	2.29	833
ELEVENTH STREET CANAL at mouth	4.20	758
CANAL BETWEEN at mouth	0.49	154

Inundation from the Atlantic Ocean caused by passage of storms (storm surge) was determined by the joint probability method (Reference 8). The storm populations were described by probability distributions of five parameters that influence surge heights. These parameters were central pressure depression (which measures the intensity of the storm), radius to maximum winds, forward speed of the storm, shoreline crossing point, and crossing angle. These characteristics were described statistically based on an analysis of observed storms in the vicinity of the City of Daytona Beach. Primary sources of data for this analysis were "Tropical Cyclones of the North Atlantic Ocean, 1871-1977," "Some Climatological Characteristics of Hurricanes and Tropical Storms, Gulf and East Coasts of the United States," and "Meteorological Criteria for Standard Project Hurricane and Probable Maximum Hurricane Wind Fields, Gulf and East Coasts of the United States" (References 9-11).

For areas subject to flooding directly from the Atlantic Ocean, the FEMA standard storm surge model was used to simulate the coastal surge generated by any chosen storm (that is, any combination of the five storm parameters defined previously). By performing such simulations for a large number of storms, each of known total probability, the frequency distribution of surge height can be established as a function of coastal location. These distributions incorporate the large-scale surge behavior, but do not include an analysis of the added effects associated with much finer scale wave phenomena, such as wave height or runup. As the final step in the calculations, the astronomic tide for the region is then statistically combined with the computed storm surge to yield recurrence intervals of total water level (Reference 12).

The storm-surge elevations for the 10-, 50-, 100-, and 500-year floods have been determined for the City of Daytona Beach and are shown in Table 2, Summary of Stillwater Elevations. The analyses reported herein reflect the stillwater elevations due to tidal and wind setup effects but do not include the contributions from wave action effects.

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of flooding from the riverine sources studied were carried out to provide estimates of the elevations of floods of the selected recurrence intervals.

Hydraulic data were obtained from the city's drainage facility inventory, survey, and field identification.

Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles and on the Flood Insurance Rate Map.

The EXTRAN computer model (Reference 7) was used to calculate water-surface profiles for the Tomoka River and the Tomoka River tributaries. EXTRAN is a hydraulic flow routing model for open channel and/or closed conduit systems. It uses a link-node representation of the drainage system in an explicit finite difference solution of the equations of gradually varied, unsteady flow. The EXTRAN model received hydrograph input at specific nodal locations by disk file transfer from the RUNOFF hydrologic model (Reference 6). The EXTRAN model performs dynamic routing of stormwater flows through the major storm drainage system to the points of outfall to the receiving water system.

Roughness coefficients (Manning's "n") used in the hydraulic computations were chosen on the basis of field observations and aerial photographs of the streams and floodplain areas. Roughness values for the main channels ranged from 0.035 to 0.06 and overbank values ranged from 0.045 to 0.15.

Flood profiles were drawn showing the computed water-surface elevations for the 100-year recurrence flood.

The hydraulic analyses for this study area based only on the effects of unobstructed flow. The flood elevations shown on the profiles are thus considered valid only if hydraulic structures remain unobstructed, operate properly, and do not fail.

Hydraulic analyses, considering storm characteristics and the shoreline and bathymetric characteristics of the flooding sources studied, were carried out to provide estimates of the elevations of floods of the selected recurrence intervals along each of the shorelines.

FLOODING SOURCE AND TRANSECT	FLOODING INSURANCE RATE MAP PANEL	STILLWATER ELEVATION, FEET MVD				ZONE	BASE FLOOD ELEVATION, FEET MVD
		10 YEAR	50 YEAR	100 YEAR	100 YEAR		
ATLANTIC OCEAN 1 5	0003.0004	5.7 5.7	7.2 7.2	8.0 8.0	10.8 10.8	VE AE	10.12 9.10
ATLANTIC OCEAN-HALIFAX RIVER INTRACOASTAL WATERWAY 1 5 1 5 NA	0003 0004 0003.0004	4.7 4.7 3.7	6.2 6.2 5.2	7.0 7.0 6.0	9.8 9.8 8.8	AE AE AE	7 7.9 6.7

ROUNDED TO THE NEAREST FOOT AND MAY INCLUDE EFFECTS OF WAVE ACTION
DUE TO MAP SCALE LIMITATIONS. BASE FLOOD ELEVATIONS SHOWN ON MAP MAY REPRESENT AVERAGE ELEVATIONS
FOR THE ZONES DEPICTED

TABLE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF DAYTONA BEACH, FL
(VOLUSIA CO.)

SUMMARY OF STILLWATER ELEVATIONS

ATLANTIC OCEAN-HALIFAX RIVER/INTRACOASTAL WATERWAY

The FEMA storm surge model was utilized to simulate the hydrodynamic behavior of the surge generated by the various synthetic storms. This model utilizes a grid pattern approximating the geographical features of the study area and the adjoining areas. Surges were computed utilizing grids of 5 nautical miles, and 1,000 feet, depending on the resolution required.

The methodology for analyzing the effects of wave heights associated with coastal storm surge flooding is described in a report prepared by the National Academy of Sciences (Reference 13). This method is based on the following major concepts. First, depth-limited waves in shallow water reach a maximum breaking height that is equal to 0.78 times the stillwater depth. The wave crest is 70 percent of the total wave height above the stillwater level. Second, wave height may be diminished by dissipation of energy due to the presence of obstructions, such as sand dunes, dikes and seawalls, buildings, and vegetation. The amount of energy dissipation is a function of the physical characteristics of the obstruction and is determined by established procedures (Reference 13). Third, wave height can be regenerated in open fetch areas due to the transfer of wind energy to the water. This added energy is related to fetch length and depth.

Wave heights were computed along transects (cross-section lines) that were located along the coastal areas, as illustrated in Figure 2, Transect Location Map, in accordance with the "Users Manual for Wave Height Analysis" (Reference 12). The transects were located with consideration given to the physical and cultural characteristics of the land so that they would closely represent conditions in their locality. Transects were spaced close together in areas of complex topography and dense development. In areas having more uniform characteristics, they were spaced at large intervals. It was also necessary to locate transects in areas where unique flooding existed and in areas where computed wave heights varied significantly between adjacent transects.

Each transect was taken perpendicular to the shoreline and extended inland to a point where wave action ceased. Along each transect, wave heights and elevations were computed considering the combined effects of changes in ground elevation, vegetation, and physical features. The stillwater elevations for the 100-year flood were used as the starting elevations for these computations. Wave heights were calculated to the nearest 0.1 foot, and wave elevations were determined at whole-foot increments along the transects. The location of the 3-foot breaking wave for determining the terminus of the V zone (area with velocity wave action) was also computed at each transect. Table 3 provides a listing of the transect locations and stillwater starting elevations, as well as initial wave crest elevations.

Figure 3 represents a sample transect that illustrates the relationship between the stillwater elevation, the wave crest elevation, the ground elevation profile, and the location of the V/A zone boundary.

BLANK

PAGE

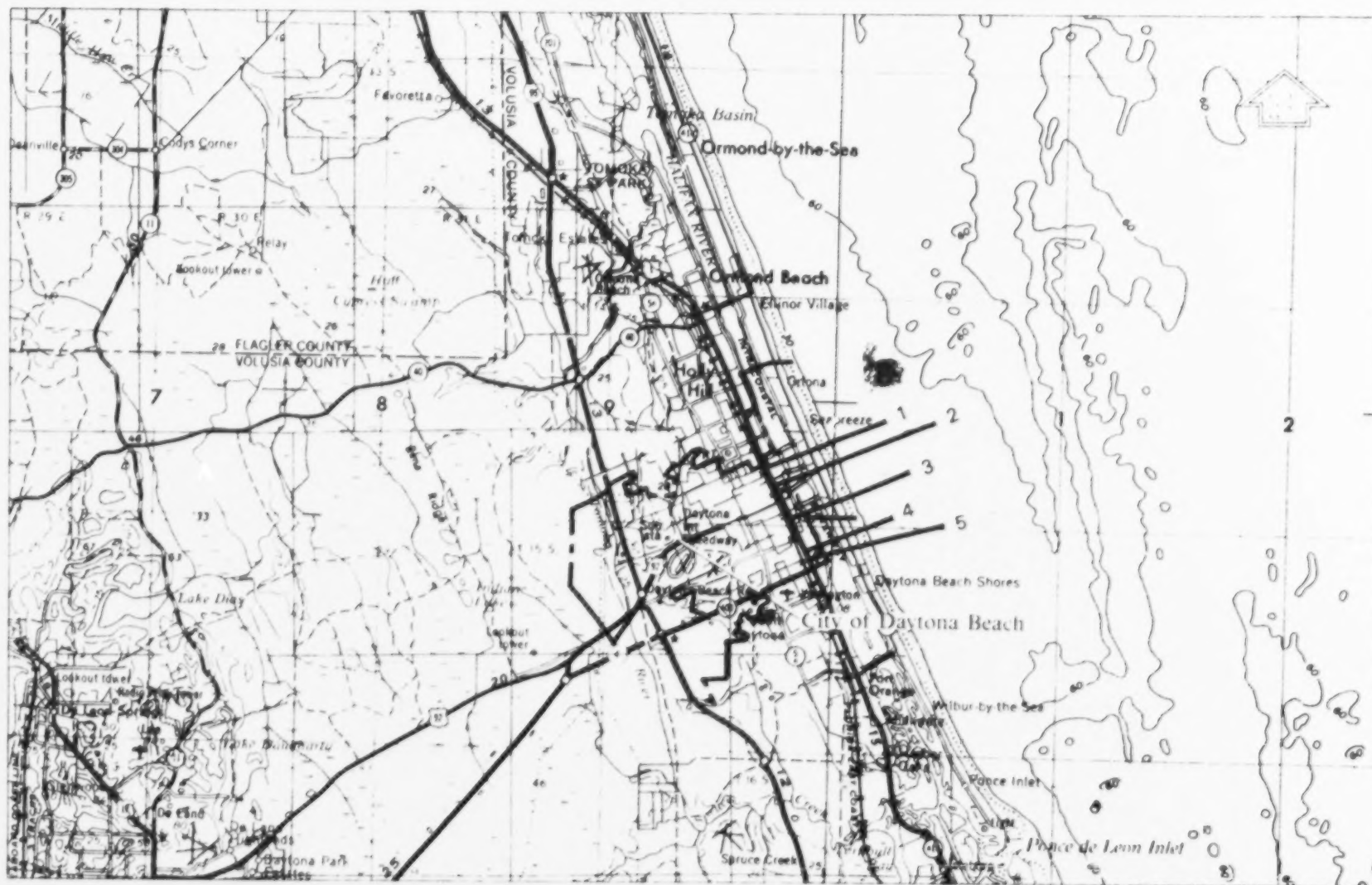


FIGURE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF DAYTON BEACH, FL
(VOLUSIA CO.)

APPROXIMATE SCALE



TRANSECT LOCATION MAP

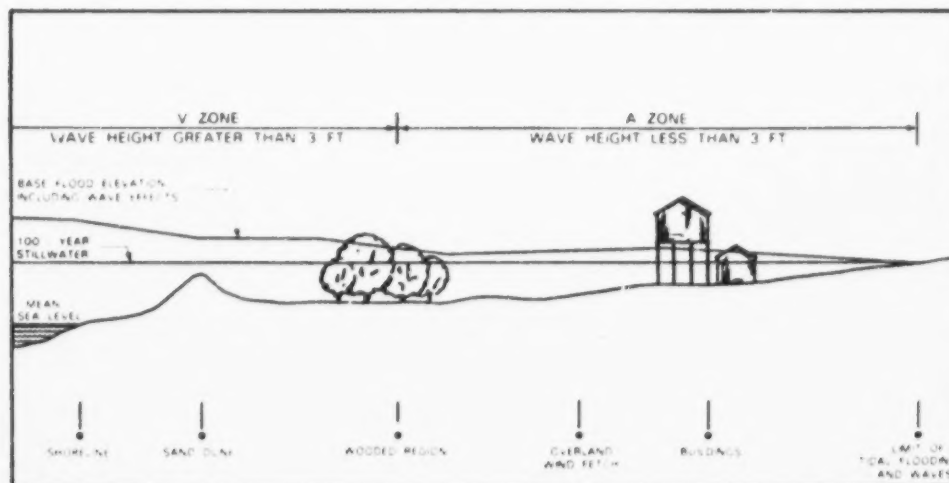


FIGURE 3 - Transect Schematic

TABLE 3 - TRANSECT LOCATIONS, STILLWATER STARTING ELEVATIONS, AND INITIAL WAVE CREST ELEVATIONS

TRANSECT	LOCATION	ELEVATION (FEET)	
		STILLWATER	WAVE CREST
1	Between Earl Street and Auditorium Boulevard from the Atlantic coastline westward across the Halifax River/Intracoastal Waterway floodplain	8.0 ¹	12 ¹
2	Between Kemp Street and Fifth Avenue from the Atlantic coastline westward across the Halifax River/Intracoastal Waterway floodplain	8.0 ¹	12 ¹
3	Between Wisteria Road and Poinsetta Road from the Atlantic coastline westward across the Halifax River/Intracoastal Waterway floodplain	8.0 ¹	12 ¹

TABLE 3 - TRANSECT LOCATIONS, STILLWATER STARTING ELEVATIONS, AND INITIAL WAVE CREST ELEVATIONS (Continued)

TRANSECT	LOCATION	ELEVATION (FEET)	
		STILLWATER	WAVE CREST
4	Between Browning Avenue and Bonner Avenue from the Atlantic coastline westward across the Halifax River/ Intracoastal Waterway floodplain into Daytona Beach between Osceola Avenue and Wilder Boulevard	7.0 ²	8 ²
5	Between Lindley Road and Bridgeport Road from the Atlantic coastline westward across the Halifax River/ Intracoastal Waterway floodplain into Daytona Beach between Wilder Boulevard and Seminole Avenue	7.0 ²	9 ²

¹Atlantic Ocean

²Halifax River/Intracoastal Waterway

After analyzing wave heights along each transect, wave elevations were interpolated between transects. Various source data were used in the interpolation, including topographic maps (References 14 and 15), beach profiles (Reference 16), aerial photographs (References 17 and 18), and engineering judgment. Controlling features affecting the elevations were identified and considered in relation to their positions at a particular transect and their variation between transects.

All elevations are referenced to the National Geodetic Vertical Datum of 1929 (NGVD).

4.0 FLOODPLAIN MANAGEMENT APPLICATIONS

The National Flood Insurance Program encourages State and local governments to adopt sound floodplain management programs. Therefore, each Flood Insurance Study provides 100-year flood elevations and delineations of the 100- and 500-year floodplain boundaries and 100-year floodway to assist communities in developing floodplain management measures.

4.1 Floodplain Boundaries

To provide a national standard without regional discrimination, the 1-percent annual chance (100-year) flood has been adopted by FEMA as the base flood for floodplain management purposes. The 0.2-percent annual chance (500-year) flood is employed to indicate additional areas of flood risk in the community. For each stream studied in detail, the 100- and 500-year floodplain boundaries have been delineated using the flood elevations determined at each cross section. Between cross sections, the boundaries were interpolated using topographic maps at a scale of 1:12000 with a contour interval of 2 feet (Reference 19). For each coastal flooding source studied in detail, the 100- and 500-year floodplain boundaries have been delineated using the flood elevations determined at each transect. Between transects, the boundaries were interpolated using topographic maps at a scale of 1:24000 with a contour interval of 5 feet (Reference 14).

The 100- and 500-year floodplain boundaries are shown on the Flood Insurance Rate Map. On this map, the 100-year floodplain boundary corresponds to the boundary of the areas of special flood hazards (Zones A, AE, AH, AO, A99, V, and VE) and the 500-year floodplain boundary corresponds to the boundary of areas of moderate flood hazards. In cases where the 100- and 500-year floodplain boundaries are close together, only the 100-year floodplain boundary has been shown. Small areas within the floodplain boundaries may lie above the flood elevations but cannot be shown due to limitations of the map scale and/or lack of detailed topographic data.

For the flooding sources studied by approximate methods, only the 100-year floodplain boundary is shown on the Flood Insurance Rate Map.

4.2 Floodways

Encroachment on floodplains, such as structures and fill, reduces the flood-carrying capacity, increases the flood heights and velocities, and increases flood hazards in areas beyond the encroachment itself. One aspect of floodplain management involves balancing the economic gain from floodplain development against the resulting increase in flood hazard. For purposes of the National Flood Insurance Program, a floodway is used as a tool to assist local communities in this aspect of floodplain management. Under this concept, the area of the 100-year floodplain is divided into a floodway and a floodway fringe. The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 100-year flood can be carried without substantial increases in flood heights. Minimum Federal standards limit such increases to 1.0 foot, provided that hazardous velocities are not produced. The floodways in this study are presented to local agencies as minimum standards that can be adopted directly or that can be used as a basis for additional floodway studies.

The floodway for the Tomoka River within the City of Daytona Beach is based on the HEC-2 water-surface profile computer model (Reference 20), performed in preparation for the Flood Insurance Study for the

Unincorporated Areas of Volusia County (Reference 3). The 100-year flood elevations presented in Table 4. Floodway Data reflect the EXTRAN analysis for the Tomoka River described in Section 3.2. The "with floodway" elevations were estimated by adding the surcharge value from the HEC-2 model to the "without floodway" elevations computed by the EXTRAN model. All other data presented in Table 4 are from the HEC-2 model for the Tomoka River. The computed floodways are shown on the Flood Insurance Rate Map. In cases where the floodway and the 100-year floodplain boundaries are either close together or collinear, only the floodway boundary is shown.

The area between the floodway and the 100-year floodplain boundaries is termed the floodway fringe. The floodway fringe encompasses the portion of the floodplain that could be completely obstructed without increasing the water-surface elevation of the 100-year flood by more than 1.0 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to floodplain development are shown in Figure 4.

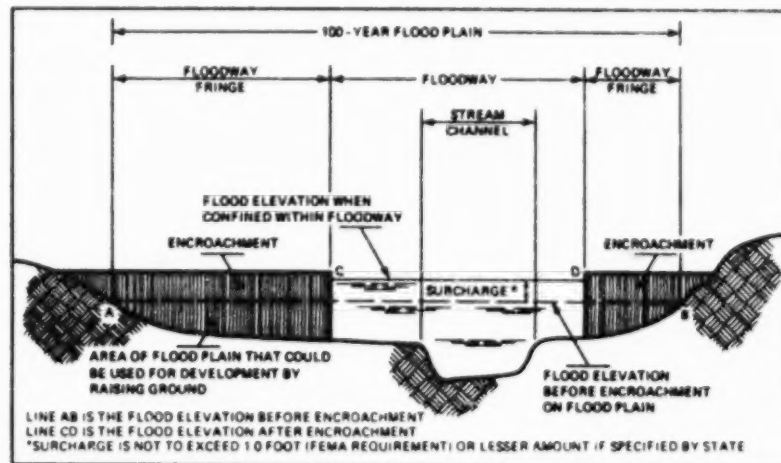


FIGURE 4 - Floodway Schematic

5.0 INSURANCE APPLICATION

For flood insurance rating purposes, flood insurance zone designations are assigned to a community based on the results of the engineering analyses. These zones are as follows:

Zone A

Zone A is the flood insurance rate zone that corresponds to the 100-year floodplains that are determined in the Flood Insurance Study by approximate methods. Because detailed hydraulic analyses are not performed for such areas, no base flood elevations or depths are shown within this zone.

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE'	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET/SEC)	REGULATORY (FEET NGVD)	WITHOUT FLOODWAY (FEET NGVD)	WITH FLOODWAY (FEET NGVD)	INCREASE (FEET)
TOMOKA RIVER								
A	64,048	445	3685	1.3	15.2	15.2	16.1	0.9
B	67,098	412	3290	1.3	16.7	16.7	17.7	1.0
C	72,717	435	3916	1.1	19.5	19.5	20.5	1.0
D	80,953	271	1932	1.1	23.7	23.7	24.7	1.0

'FEET ABOVE MOUTH

TABLE 4

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF DAYTONA BEACH, FL
(VOLUSIA CO.)

FLOODWAY DATA

TOMOKA RIVER

Zone AE

Zone AE is the flood insurance rate zone that corresponds to the 100-year floodplains that are determined in the Flood Insurance Study by detailed methods. Whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone AH

Zone AH is the flood insurance rate zone that corresponds to the areas of 100-year shallow flooding (usually areas of ponding) where average depths are between 1 foot and 3 feet. Whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone VE

Zone VE is the flood insurance rate zone that corresponds to the 100-year coastal floodplains that have additional hazards associated with storm waves. Whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone X

Zone X is the flood insurance rate zone that corresponds to areas outside the 100-year floodplain, areas of 100-year flooding where average depths are less than 1 foot, areas of 100-year flooding where the contributing drainage area is less than 1 square mile, and areas protected from the 100-year flood by levees. No base flood elevations or depths are shown within this zone.

6.0 FLOOD INSURANCE RATE MAP

The Flood Insurance Rate Map is designed for flood insurance and floodplain management applications.

For flood insurance applications, the map designates flood insurance rate zones as described in Section 5.0 and, in the 100-year floodplains that were studied by detailed methods, shows selected whole-foot base flood elevations or average depths. Insurance agents use the zones and base flood elevations in conjunction with information on structures and their contents to assign premium rates for flood insurance policies.

For floodplain management applications, the map shows by tints, screens, and symbols the 100- and 500-year floodplains, the floodways, and the locations of selected cross sections used in the hydraulic analyses and floodway computations.

7.0 OTHER STUDIES

A Flood Insurance Study prepared for the City of Holly Hill, Florida (Reference 21) is in agreement with this study.

Revisions in progress to the published Flood Insurance Studies for Volusia County, the City of Ormond Beach, the City of South Daytona, and the City of West Orange, Florida (References 22-24) are in agreement with this study.

This Flood Insurance Study supersedes the previously published Flood Insurance Study for the City of Daytona Beach (Reference 1).

8.0 LOCATION OF DATA

Information concerning the pertinent data used in the preparation of this study can be obtained by contacting the Natural and Technological Hazards Division, FEMA, 1371 Peachtree Street, NE., Suite 736, Atlanta, Georgia 30309.

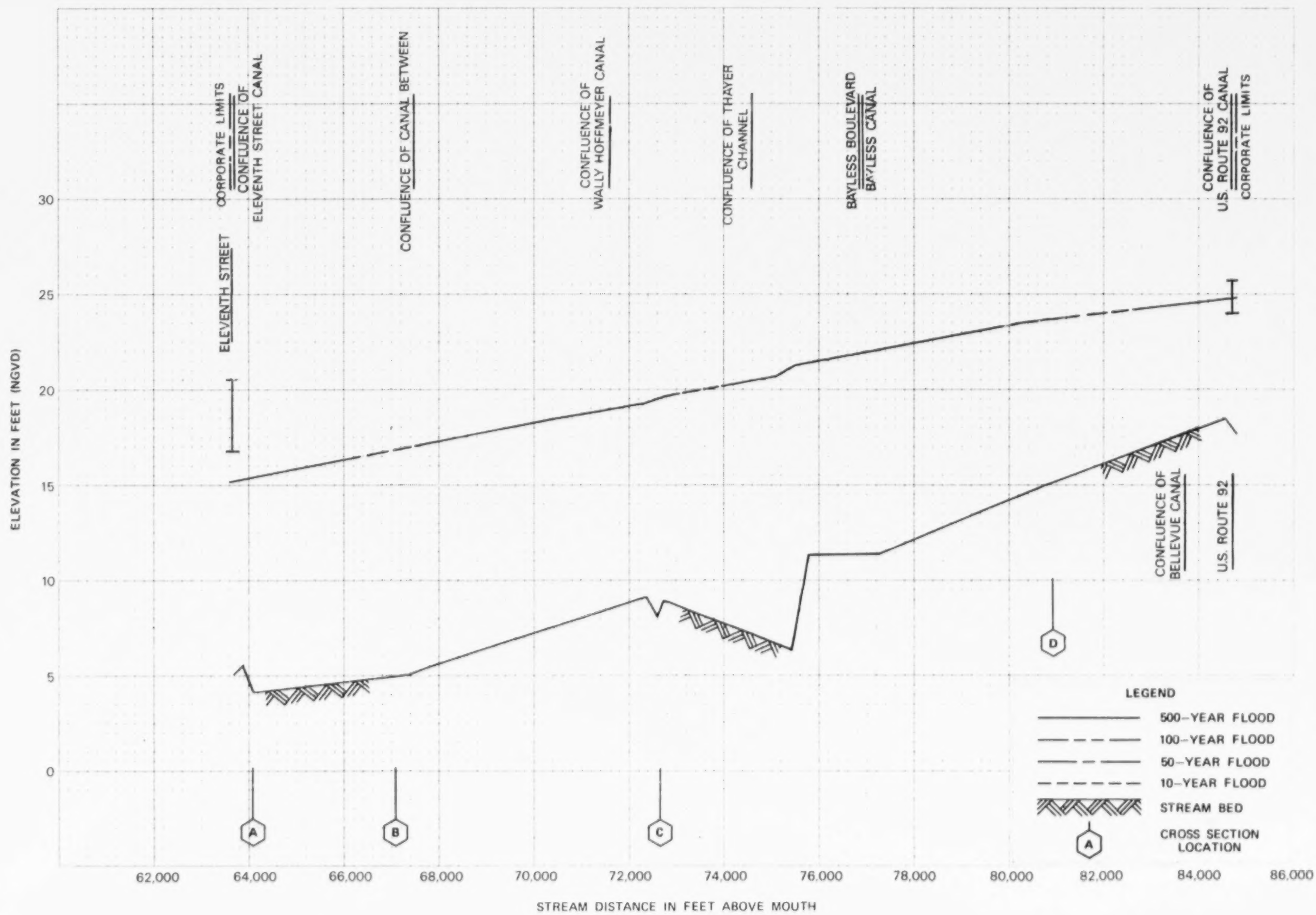
Future revisions may be made that do not result in the republishing of the Flood Insurance Study report. To assure that any user is aware of all revisions, it is advisable to contact the map repository of flood hazard data located in the community.

9.0 REFERENCES AND BIBLIOGRAPHY

1. Federal Emergency Management Agency, Flood Insurance Study, City of Daytona Beach, Volusia County, Florida, September 1982.
2. Camp Dresser & McKee, Inc., Tomoka River and B-19 Canal 100-year Flood Results for the City of Daytona Beach, November 1988, revised March 1989.
3. Federal Emergency Management Agency, Flood Insurance Study, Volusia County, Unincorporated Areas, Florida, October 1983, revision in progress.
4. U.S. Department of Commerce, Bureau of the Census, 1980 Census of Population, Number of Inhabitants, Florida, Washington, D.C., February 1982.
5. U.S. Environmental Protection Agency, Municipal Environmental Research Center, Office of Research and Development, Storm Water Management Model User's Manual Version III, Huber, W.C., et al., Cincinnati, Ohio, November 1981, Second Printing May 1982.
6. Camp Dresser & McKee Inc., Runoff Users Manual and Documentation, Annandale, Virginia, October 1988.
7. ———, EXTRAN User's Manual and Program Documentation, Roesner, L.A., et al., Annandale, Virginia, October 1988.
8. U.S. Department of Commerce, Environmental Sciences Services Administration, Technical Memorandum WBTM, Hydro 11, Joint Probability Method of Tide Frequency Analysis Applied to Atlantic City and Long Beach Island, New Jersey, Vance A. Myers, April 1970.
9. ———, National Oceanic and Atmospheric Administration, National Weather Service, Tropical Cyclones of the North Atlantic Ocean, 1871-1977, June 1978.

10. ———, National Oceanic and Atmospheric Administration, Technical Report NWS 15, Some Climatological Characteristics of Hurricanes and Tropical Storms, Gulf and East Coasts of the United States, Francis P. Ho, Richard W. Schwerdt, and Hugo V. Goodyear, May 1975.
11. ———, National Oceanic and Atmospheric Administration, Technical Report NWS 23, Meteorological Criteria for Standard Project Hurricane and Probable Maximum Hurricane Wind Fields, Gulf and East Coasts of the United States, Richard W. Schwerdt, Francis P. Ho, and Roger R. Watkins, 1979.
12. Federal Emergency Management Agency, Users Manual for Wave Height Analysis, revised February 1981.
13. National Academy of Sciences, Methodology for Calculating Wave Action Effects Associated with Storm Surges, 1977.
14. U.S. Geological Survey, 7.5 Minute Series Topographic Maps, Scale 1:24000, Contour Interval 5 Feet: Ormond Beach, Florida, 1956, photorevised 1970; Daytona Beach, Florida, 1952, photorevised 1970; Port Orange, Florida, 1956, photorevised 1970.
15. Research Planning Institute, Inc., Plates 1-3, 3-Foot, 4-Foot, and 7-Foot Flood Elevation, Halifax Plantation, NE Volusia County, Scale 1:18000, Contour Interval 2 Feet: Columbia, South Carolina, 1978.
16. Florida Department of Natural Resources, Bureau of Beaches and Shores, Volusia County Beach Profiles, Scale 1:600, 1972.
17. Federal Emergency Management Agency, Stereoscopic Aerial Photography of Volusia County, Florida, Scale 1:12000, January 1981.
18. Florida Department of Transportation, Stereoscopic Aerial Photography of Volusia County, Florida, Scale 1:12000, August 1978.
19. City of Daytona Beach, Florida, Aerial Topography with Contours, Scale 1:12000, Contour Interval 2 Feet: Daytona Beach, Florida, January 1983.
20. U.S. Army Corps of Engineers, Hydrologic Engineering Center, HEC-2 Water Surface Profiles, Generalized Computer Program, Davis, California, November 1976.
21. U.S. Department of Housing and Urban Development, Federal Insurance Administration, Flood Insurance Study, City of Holly Hill, Volusia County, Florida, April 1977.
22. Federal Emergency Management Agency, Flood Insurance Study, City of Ormond Beach, Volusia County, Florida, September 1982, revision in progress.
23. ———, Flood Insurance Study, City of South Daytona, Volusia County, Florida, October 1976, revision in progress.

24. ———, Flood Insurance Study, City of Port Orange, Volusia County, Florida, September 1989, revision in progress.

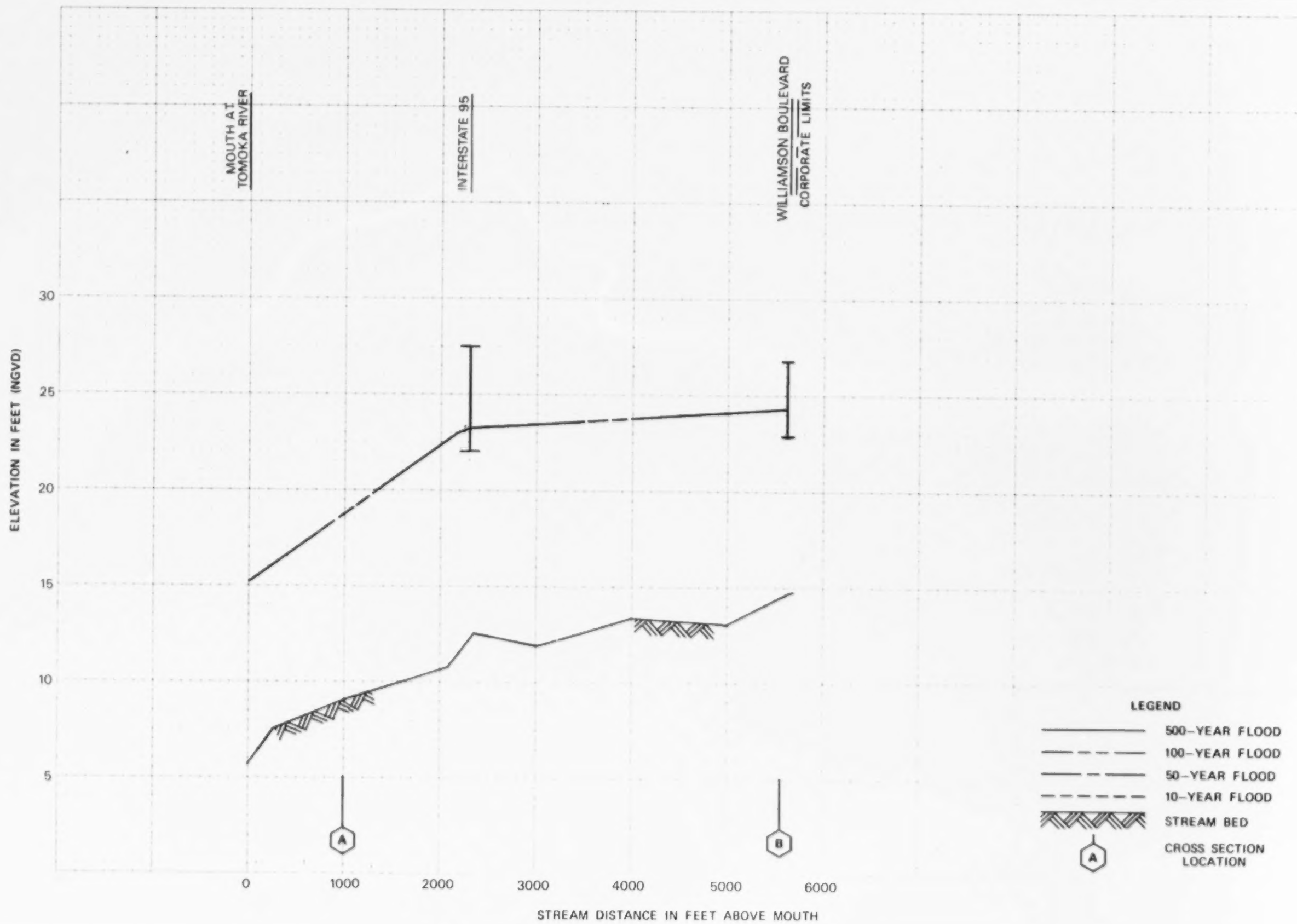


FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF DAYTONA BEACH, FL
(VOLUSIA CO.)

FLOOD PROFILES

TOMOKA RIVER



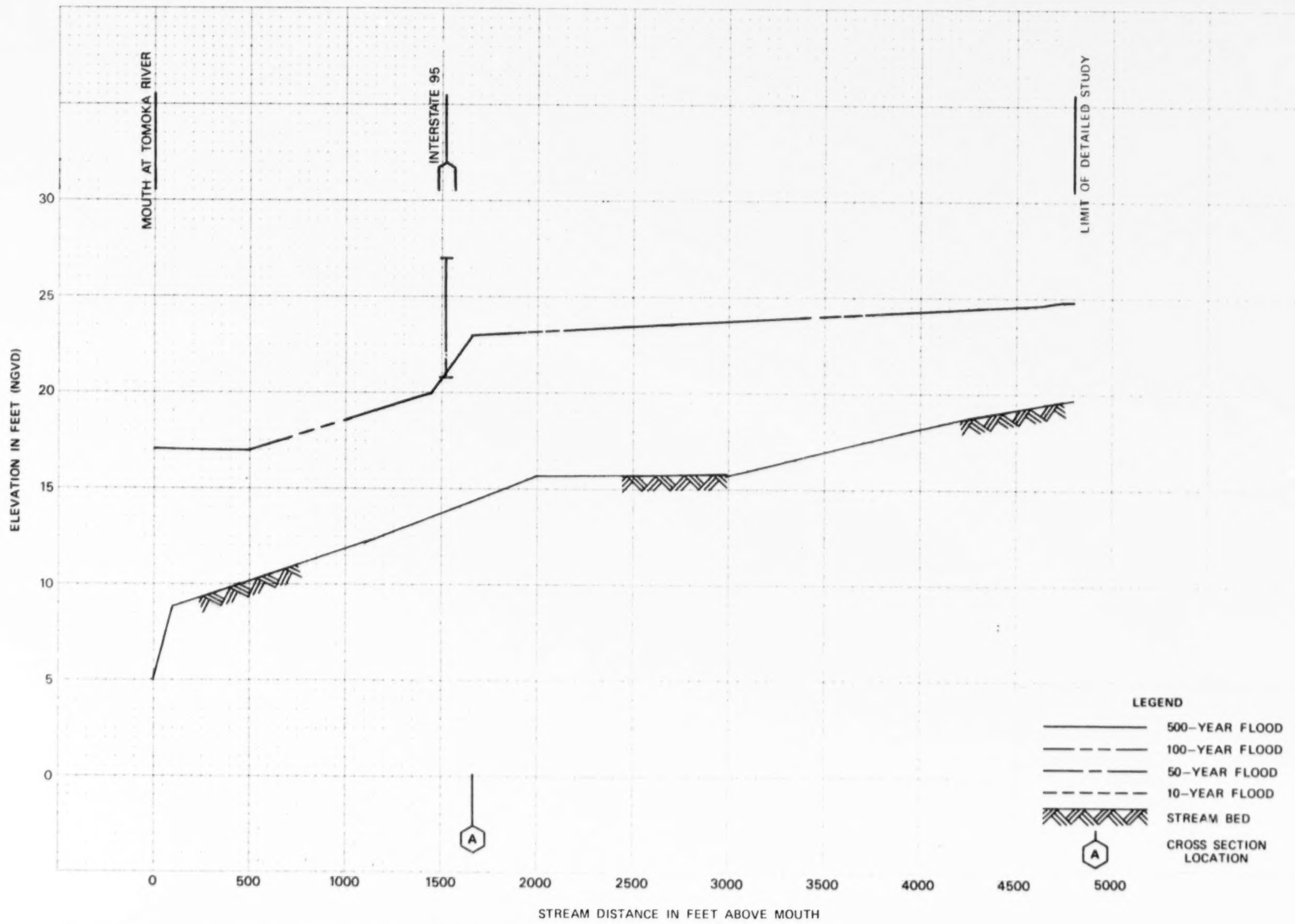
FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF DAYTONA BEACH, FL
(VOLUSIA CO.)

FLOOD PROFILES

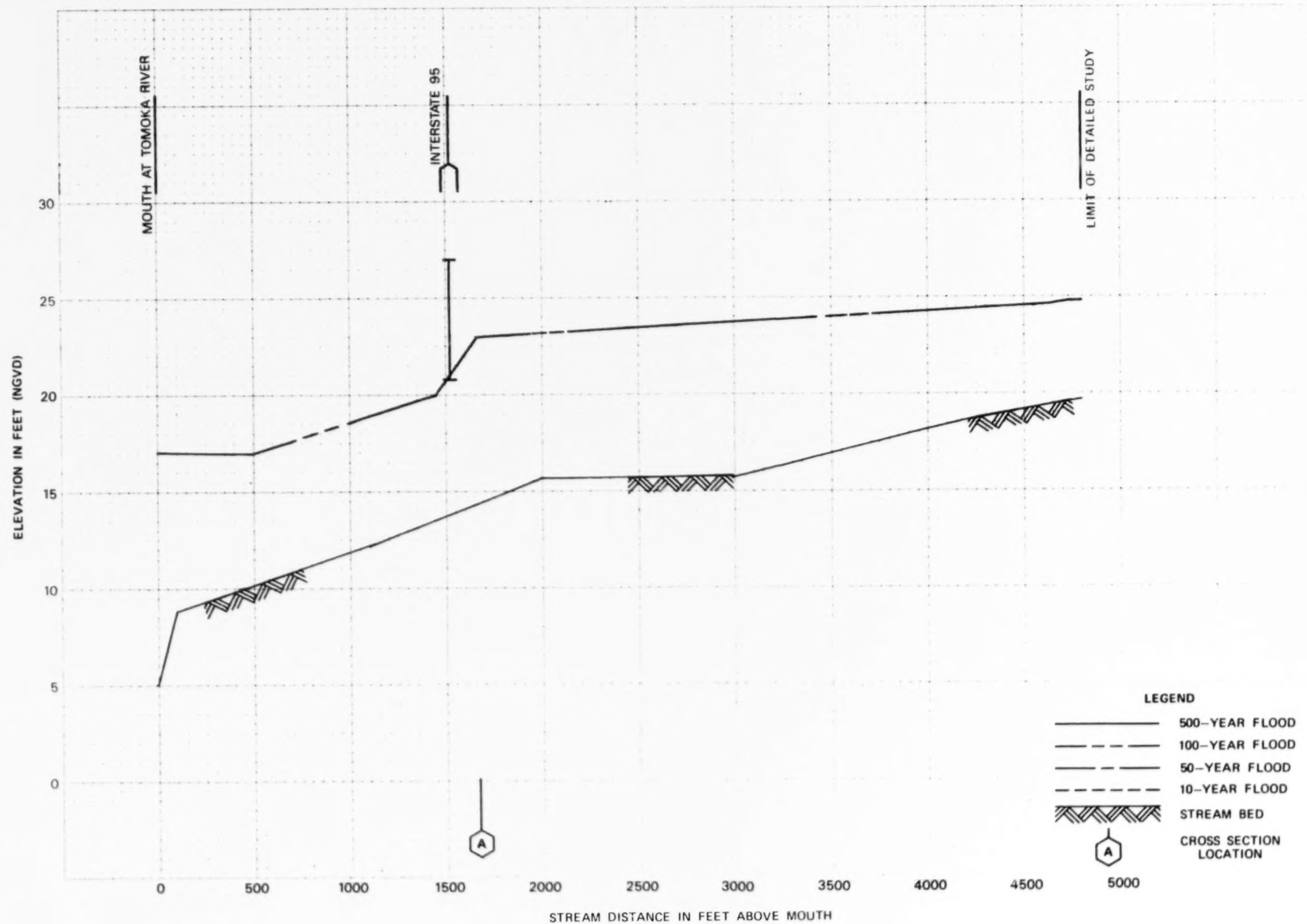
ELEVENTH STREET CANAL

02P



FEDERAL EMERGENCY MANAGEMENT AGENCY
CITY OF DAYTONA BEACH, FL
 (VOLUSIA CO.)

FLOOD PROFILES
CANAL BETWEEN



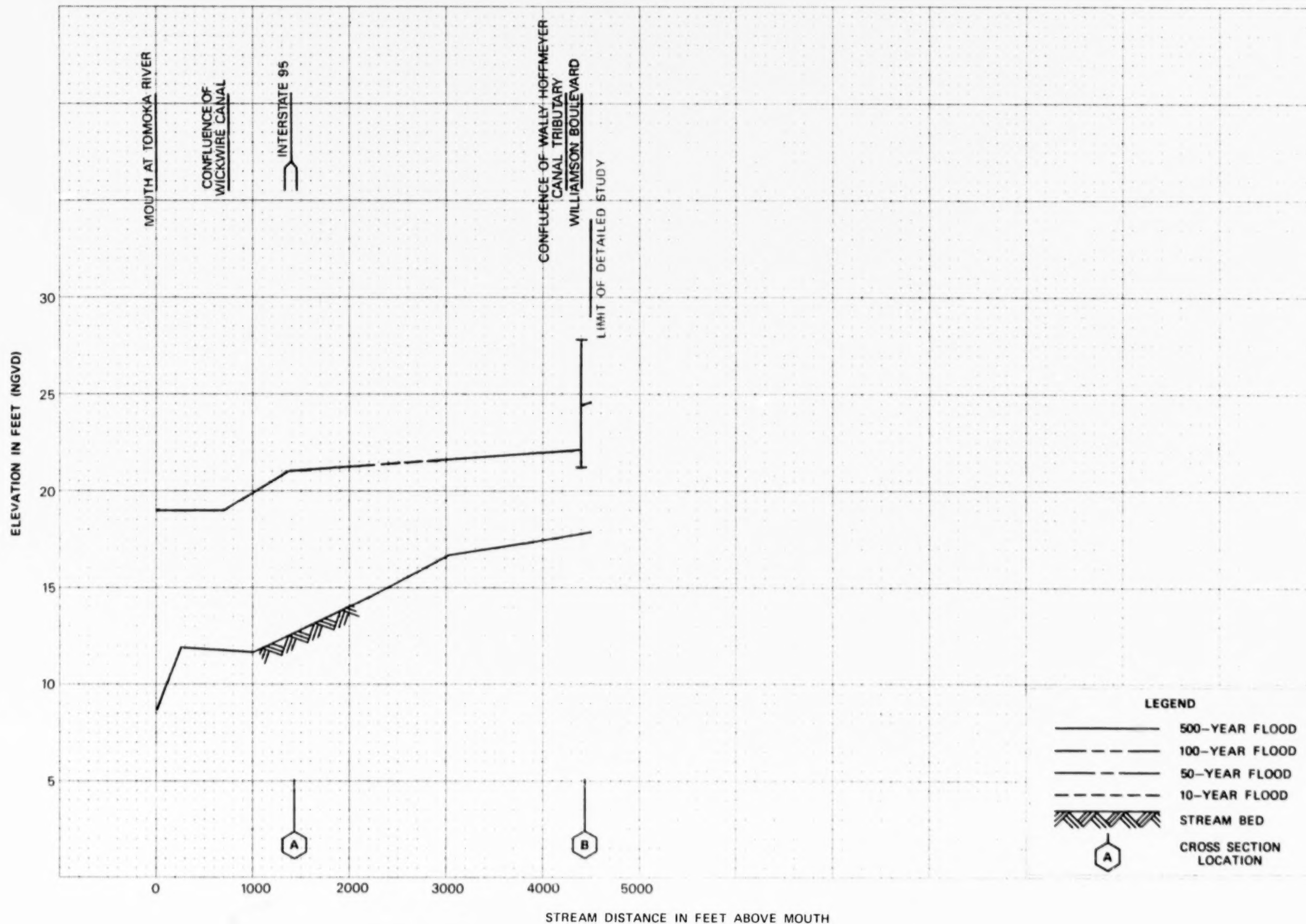
FLOOD PROFILES

CANAL BETWEEN

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF DAYTONA BEACH, FL
(VOLUSIA CO.)

03P



FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF DAYTONA BEACH, FL
(VOLUSIA CO.)

FLOOD PROFILES

WALLY HOFFMEYER CANAL

04P